UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

DEC 5 2002

In Reply Refer To:
SWR-99-SA-1125:FKF

Mr. Kenneth E. Hitch, P.E.
Chief , Planning Division
U. S. Army Corps of Engineers
Environmental Resources Branch
1325 J Street
Sacramento, California 95814-2922

Dear Mr. Hitch:

Enclosed is a biological opinion (Enclosure 1) prepared pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (USC 1531 *et seq.*) which analyzes impacts to threatened Central Valley steelhead (*Oncorhynchus mykiss*) resulting from continued operations of the New Hogan Dam and Lake project by the U.S. Army Corps of Engineers (Corps). Also, as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended (16 U.S.C. 1801 *et seq.*), the National Marine Fisheries Service's (NOAA Fisheries) Essential Fish Habitat (EFH) Conservation Recommendations for Pacific coast salmon which may be affected by the proposed action also are enclosed (Enclosure 2).

Endangered Species Act Consultation

Based on the best available scientific and commercial information, NOAA Fisheries concludes that the proposed project is not likely to jeopardize the continued existence of Central Valley steelhead. An Incidental Take Statement is included with the biological opinion that identifies Reasonable and Prudent Measures and Terms and Conditions to implement those measures, to ensure that the impacts of any incidental take are minimized.

Consultation with NOAA Fisheries must be reinitiated if (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals that the project may affect listed species in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed, or critical habitat is designated that may be affected by the project.

Essential Fish Habitat Consultation

NOAA Fisheries has provided four EFH Conservation Recommendations for Pacific salmon. The Corps has a statutory requirement under section 305(b)(4)(B) of the MSFCMA to submit a detailed response in writing to NOAA Fisheries that includes a description of measures proposed for avoiding, mitigating, or offsetting the impact of the activity on EFH, as required by section 305(b)(4)(B) of the MSFCMA and 50 CFR 600.920(j) within 30 days. If unable to complete a final response within 30 days of final approval, the Corps should provide NOAA Fisheries an interim written response within 30 days. The Corps should then provide a detailed response.

If you have any questions about this consultation please contact Ms. F. Kelly Finn in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Ms. Finn may be reached by telephone at (916) 930-3600 or by Fax at (916) 930-3629.

Sincerely,

for Rodney R. McInnis
Acting Regional Administrator

cc: NOAA Fisheries-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NOAA Fisheries, Sacramento, CA

Enclosure 1
Endangered Species Act -Section 7 Consultation

BIOLOGICAL OPINION

Agency: U.S. Army Corps of Engineers, Sacramento District

Activity: New Hogan Dam and Lake Project

Consultation
Conducted By: Southwest Region, National Marine Fisheries Service (NOAA Fisheries)

Date Issued: DEC 5 2002

I. BACKGROUND AND CONSULTATION HISTORY

In March, 2000, the U.S. Army Corps of Engineers (Corps) made flood control releases from New Hogan Reservoir (New Hogan) to the Calaveras River in response to storm events. As storm inflow tapered off, the Corps ramped down flood control release flows from over 1000 cubic feet per second (cfs) to less than 500 cfs within an approximate twenty-four hour period. This ramping rate is within the limits set in the Corps' 1983 Water Control Manual which requires that releases during normal flood control operations shall not be changed by more than 2,000 cfs in any two-hour period. However, when flow releases are at or above approximately 1000 cfs a section of the river channel, which will be referred to as the overflow area, becomes submerged, however, at flows of 500 cfs this area becomes devoid of water. During the 2000 winter season flow releases were continually above 1000 cfs from February 15, 2000 through March 11, 2000 and on March 12 flows were decreased to 841 cfs, on March 13 to 503 cfs, and continued to be decreased over the next few weeks to approximately 202 cfs. During the period when flows were in excess of 1000 cfs threatened Central Valley steelhead (*Oncorhynchus mykiss*) and rainbow trout (*O. mykiss*) were inhabiting the overflow area, perhaps seeking suitable spawning areas. Steelhead and rainbow trout were present in the overflow area during the rampdown and were consequently stranded when flows were decreased. The rampdown and dewatering of the overflow area on March 13, 2000, resulted in the stranding of approximately 21 fish according to reports of local anglers. Thirteen *O. mykiss* were reported to have been relocated to deeper water by local anglers, and eight were found dead.

This event occurred prior to NOAA Fisheries' completion and official publication of the 4(d) rule which establishes protective regulations to threatened species under the Endangered Species Act (ESA). The fish stranding resulted in public and regulatory concern for the protection of steelhead within the Calaveras River drainage. A Public Trust Complaint was filed by the

California Sportfishing Alliance, Delta Keeper, and the Committee to Save the Mokelumne against the Bureau of Reclamation (BOR), Stockton East Water District (SEWD), Calaveras County Water District (CCWD), and the Corps on March 22, 2000 regarding diversions from the Calaveras River. A letter from the State Water Resources Control Board (SWRCB) dated April 25, 2000 requesting information regarding the public trust complaint was received by NOAA Fisheries. NOAA Fisheries received a copy of a letter on June 12, 2000, written by the SWRCB to the Corps and BOR on May 17, 2000 requesting the parties named in the public trust complaint respond by June 30, 2000. A response letter was drafted by NOAA Fisheries on September 21, 2000, however, it was later determined to have not been sent out and was updated and sent out on January 23, 2001.

Prior to initiation of consultation, discussions and planning meetings were held by federal agencies, including the Corps, NOAA Fisheries, BOR, and the U.S. Fish and Wildlife Service (FWS); the California Department of Fish & Game, Stockton East and Calaveras County Water districts, and various environmental consultants. The Corps initiated consultation under Section 7 of the ESA in order to secure protection from any potential future actions which may result in a take occurring as a result of their flood control operations. Meetings and site visits were held on March 16, 2000; October 17, 2000; October 19, 2000; February 8, 2001; June 13, 2001; August 16, 2001; September 10, 2001; and October 3, 2001. NOAA Fisheries received a request for formal consultation pursuant to Section 7(a)(2) of the Endangered Species Act on April 19, 2001. Consultation was not initiated by NOAA Fisheries at this time because negotiations, meetings, and coordination between NOAA Fisheries and the Corps were ongoing. Coordination and review continued until March, 2002 with additional comments by the Corps received on March 18, 2002. Formal consultation was resumed by NOAA Fisheries on or around this date.

II. DESCRIPTION OF PROPOSED ACTION

Proposed Action

The Corps proposes to continue long-term operations at the New Hogan Dam and Lake Project in accordance with the Water Control Plan and Flood Control Diagram as it has since 1963. Corps inspections or maintenance of the outlet works or power plant facilities will require the outlet gates to be closed. Annual and 5-year inspections typically occur during mid-November.

New Hogan Project Facilities

New Hogan Dam and Lake are located on the Calaveras River, near Valley Springs, California, about 28 miles east of Stockton, California (Figure 1). Construction of New Hogan Dam and appurtenances began in November 1960, and was completed by June 1964. It is a combination rock and earthfill structure with a crest elevation of 725 feet above mean sea level, which is about 200 feet above the original streambed. New Hogan Dam was constructed approximately 500 feet downstream from the original Hogan Dam and reservoir built in 1930 by the City of

Stockton. The New Hogan Project is operated for flood control, municipal and industrial water supply, irrigation, and recreation purposes. The project provides flood protection for about 46,000 acres of highly developed agricultural land, and about 14,000 acres of urban and suburban land in and adjacent to the City of Stockton (Corps 1981). It captures a drainage area of 363 square miles of foothill and moderately mountainous terrain on the lower western slope of the Sierra Nevada, from elevation 550 feet at the dam to about 6,000 feet at the highest point. It has a storage capacity of 317,000 acre-feet at gross pool, with up to 165,000 acre-feet of flood control storage space during the flood season and a minimum pool (inactive pool) of 14,900 acre-feet for sediment storage, fish and wildlife, and general recreation.

Hydroelectric power generation was not a New Hogan Project authorized purpose, however, the Federal Energy Regulatory Committee (FERC) allowed a run-of-the-river hydroelectric power facility to be added to the dam in 1985. The controlled capacity through the outlet works is approximately 13,300 cfs with the power plant modification in place. The hydroelectric project has no effect on the flow releases as it is run-of-the-river project. During inspections of the power plant, the Corps makes necessary releases, and during inspections of the Corps facility, the power plant can make releases. The rated spillway capacity for the dam is approximately 106,400 cfs, however, a maximum release limit of 12,500 cfs is used as the "maximum non-damaging flow" for the Calaveras from New Hogan Dam to the San Joaquin River. All of the reservoir capacity, except for the inactive pool, is used for conservation storage when not required for flood control. The water in conservation storage is released or withdrawn at the request of interests holding water rights. Stockton East Water District (SEWD) and the Calaveras County Water District (CCWD) hold the rights to flow releases from the New Hogan Dam and Lake project through a contract between the water agencies and the Bureau of Reclamation.

New Hogan Project Operation

The Corps determines the flood control releases when the project is in flood control mode while SEWD determines the municipal and irrigation releases in non-flood control periods. Since 1964, the Corps, Sacramento District, has operated New Hogan Project for flood control in accordance with the Water Control Plan consisting of the Flood Control Diagram (Figure 4) and portions of the Water Control Manual. Flood control operations by the Corps occur when the storage in New Hogan exceeds the flood control space required at any particular time as determined under the authorized Flood Control Diagram. Flood control reservation, or space, in New Hogan Lake increases linearly from zero on October 1 to a maximum of 165,000 acre-feet (encroachment stage) by November 30. According to the Flood Control Diagram, from November 30 to December 31, a minimum flood reservation pool of 165,000 ac-ft is required. From January 1 through March 20, as much as 165,000 acre-feet of flood control reservation may be required, depending on a precipitation index of basin wetness. After March 20, flood control reservation decreases linearly to zero as early as May 8 or as late as June 9, depending on a precipitation index of basin loss rates. The maximum authorized flood control release from New Hogan Dam is 12,500 cfs. The primary flood control goal is to control flows at Bellota to downstream channel capacity (12,500 cfs). During very large floods that may cause the level in New Hogan

Lake to rise above gross pool level with consequent loss of control, operation is in accordance with the Emergency Spillway Release Diagram in the Water Control Manual.

The flood control operation each day consists of determining the required flood control reservation and scheduling releases to provide the required capacity by the end of the day, whenever possible. All project operations are the responsibility of the Water Management personnel, Sacramento District, Corps. Except during emergency spillway operations, releases from New Hogan are limited insofar as possible to 12,500 cfs, measured at Bellota based on a stage-discharge curve. According to the Flood Control Diagram, releases during normal flood control operations shall not be changed more than 2,000 cfs in any 2-hour period to permit orderly evacuation of personnel, property, livestock, etc., in advance of rising water downstream and to minimize bank caving as the flow recedes after extended periods of bankfull flows. Releases have never exceeded the 12,500 cfs even during extreme storm events. The highest release was 7,860 cfs during a storm on January 21, 1980.

The Corps performs annual pre-flood inspections of New Hogan Dam typically during mid-November, after the irrigation season. Tunnels, outlet gates, and dam walls are inspected during this time. The inspections normally last one to two days with the flows reduced, if necessary, for 5-6 hours. Flows of less than 400 cfs are maintained by using the bypass capability of the power plant. Periodic 5-year inspections are conducted similar to the annual inspections except the inspection checklist is more complete and the inspection involves personnel from Washington D.C. The next scheduled inspection is set for September, 2002. For the periodic inspection, the plunge pool is also inspected. This requires flows to be reduced or terminated through the outlets to allow pumping of all water from the plunge pool. Flows through the outlets can be bypassed through the power plant to maintain flows downstream as with annual pre-inspections. Corps personnel also conduct daily seepage and water level inspections on New Hogan Dam.

<u>Reservoir Operation-Use of Water by Districts</u>

The following reservoir operations are in effect when the flood control operations are not occurring. The contract for water supply (Contract no. 14-06-200-5057A) specifies the priority of water uses in the following section of the contract:

4. (a) "Acting through the District Engineer, at the request of the watermaster, the United States shall store, regulate and/or release all flows of the Calaveras River at New Hogan for the purpose of making available agricultural, municipal, and industrial, and domestic water for use by the Districts. Such storage, regulation, and release of water shall be subordinate only to the storage and release of water for flood control, as conclusively determined by the District Engineer; maintenance of a storage basin of fifteen thousand (15,000) acre-foot capacity for silting and storage of water for recreational and incidental uses, including recreational use on United States lands adjacent to the Reservoir; and to release of the portion of the unregulated runoff in the Calaveras River which is passed

through New Hogan as it occurs in recognition of prior downstream water rights entitlements."

Irrigation releases occur during the spring and summer seasons and begin as soon as the rainy season ends and lasts as long as the growing season requires, provided that water is available at New Hogan. The volume of the release at New Hogan Lake varies during different times of the year and from year to year depending on the amount of rainfall. In 1978, SEWD began operation of a 65-cfs-capacity diversion at Bellota, resulting in a low but sustained flow above Bellota in most years.

Other Related Water Control Facilities

SEWD operates several irrigation and municipal-industrial diversion facilities on Mormon Slough and on the Calaveras River in the vicinity of the town of Bellota and downstream of Bellota. These include the Calaveras River Headworks, Bellota Weir, and the municipal-industrial water intake facility, located between the Headworks and the Bellota Weir.

The Headworks facility consists of four reinforced concrete culverts used to limit flood flows as well as control irrigation flows down the river. Channel capacities on the Calaveras are restricted due to small cross-sections and dense vegetative overgrowth. Minimal or lack of flow on the Calaveras and Mormon Slough below Bellota in most months is attributable to the agricultural and municipal diversions which largely deplete the storage releases made into the river. During the irrigation season releases are made to the lower river and Mormon Slough to supply water for the water diversions. Mormon Slough has approximately 54 water diversions (CDFG 2002), some of which include installation of flashboard dams. The Bellota Weir is a removable check dam with flow control gates located at the face of the dam at the upstream end of Mormon Slough. This structure is used during the summer to increase the head on the Calaveras River Headworks and the M&I intake structure. The municipal-industrial water intake facility is located immediately upstream of the Bellota Weir, and downstream of the Headworks. Up to 65 cfs of flow is diverted into a 54-inch diameter underground pipeline and conveyed approximately 13 miles to the SEWD treatment plant. SEWD's other facilities are mainly small flash board dams on the Calaveras River, Mormon Slough, Mosher Creek and Potter Creek to facilitate the distribution of irrigation water.

The Mormon Slough Calaveras River Project, constructed by the Corps between September 1967 and September 1968, consists mainly of channel enlargements and realignments on Mormon Slough and the Stockton Diverting Canal. The purpose of this project was to increase the conveyance capacity of the channel downstream of New Hogan Dam to match the dam's operation design objective of 12,500 cfs.

Action Area

The action area for the New Hogan Dam and Lake project includes the project site, the Calaveras River channel and its riparian corridor downstream of New Hogan Dam to the confluence with the San Joaquin River, and including Mormon Slough downstream to the Stockton Diverting Canal.

III. STATUS OF THE SPECIES/CRITICAL HABITAT

This biological opinion analyzes the effects of the proposed project on the Central Valley steelhead Evolutionarily Significant Unit (ESU[1]) and their designated critical habitat. The Central Valley steelhead ESU was listed as threatened by NOAA Fisheries on March 19, 1998 (63 FR 13347). The ESU includes all naturally-produced steelhead (and their progeny) in the Sacramento-San Joaquin River Basin. NOAA Fisheries published a final 4(d) rule for this ESU on July 10, 2000 (65 FR 42422).

Central Valley steelhead once ranged throughout most of the tributaries and headwaters of the Sacramento and San Joaquin basins prior to dam construction, water development, and watershed perturbations of the 19^{th} and 20^{th} centuries (McEwan and Jackson 1996). Historical documentation exists that show steelhead were once widespread throughout the San Joaquin River system (CALFED 1999). In the early 1960s, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley including San Francisco Bay (DFG 1965). The annual run size for this ESU in 1991-92 was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

Impassable dams block access to most of the historical headwater spawning and rearing habitat of Central Valley steelhead. In addition, much of the remaining, accessible spawning and rearing habitat is severely degraded by elevated water temperatures, agricultural and municipal water diversions, unscreened and poorly screened water intakes, restricted and regulated streamflows, levee and bank stabilization, and poor quality and quantity of riparian and shaded riparian aquatic (SRA) cover.

Currently, in portions of the action area, state angling regulations provide for a bag limit of up to five rainbow trout (*O. mykiss*) of 16 inches maximum total length to be taken from the Calaveras River during November 1 through March 31. Some of the fish taken may be rearing steelhead, however, changes to the existing fishing regulations have been proposed for the Calaveras River

[1]For purposes of conservation under the Endangered Species Act, an ESU is a distinct population segment that is substantially reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy of the species (Waples 1991).

fishery. Portions of the San Joaquin River and Mormon Slough have been designated as impaired water bodies pursuant to section 303(d) of the Clean Water Act.

Downstream of the action area, outmigrating steelhead originating from the San Joaquin River drainage are subject to adverse conditions created by water export operations at the Central Valley and State Water Project (CVP/SWP) pumps. Specifically, migration patterns of juvenile salmonids have been adversely affected by: (1) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; and (2) entrainment at the Central Valley Project/State Water Project export facilities and associated problems at Clifton Court Forebay. Entrainment may also occur in hundreds of smaller unscreened siphons, pumps, or culverts used to provide water to agricultural lands or duck clubs throughout the Sacramento-San Joaquin Delta and Suisun Marsh.

At present, wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River (McEwan and Jackson 1996). Central Valley steelhead have been reported in the Stanislaus River, the Tuolumne, the Mokelumne, the Calaveras and Merced rivers of the San Joaquin River drainage (McEwan 2000). Steelhead in the Sacramento-San Joaquin systems combined have declined from 1-2 million fish present historically to 40-50 thousand in the 1950s (McEwan 2000). Fewer than 10,000 fish were present in the 1990s (McEwan 2000). However, the presence of naturally spawning populations appears to correlate well with the presence of fisheries monitoring programs, and recent implementation of new monitoring efforts has found steelhead in streams previously thought not to contain a population, such as Auburn Ravine, Dry Creek, and the Stanislaus River. It is possible that other naturally spawning populations exist in Central Valley streams, but are undetected due to lack of monitoring or research programs (IEP Steelhead Project Work Team 1999).

All Central Valley steelhead are currently considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940s (IEP Steelhead Project Work Team 1999). Adult Central Valley steelhead use the Delta and lower reaches of the Sacramento and San Joaquin rivers as migration corridors to return to their upstream spawning grounds. Adult steelhead migrate upstream in the Sacramento River mainstem from July through March, with peaks in September and February (Bailey 1954, Hallock et al. 1961). The timing of upstream migration is generally correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The preferred temperatures for upstream migration are between 46° F and 52° F (Bovee 1978, Reiser and Bjornn 1979, Bell 1986). Unusual stream temperatures during upstream migration periods can alter or delay migration timing, accelerate or retard mutations, and increase fish susceptibility to diseases. The minimum water depth necessary for successful upstream passage is 18 cm (Thompson 1972). Velocities of 3-4 meters per second approach the upper swimming ability of steelhead and may retard upstream migration (Reiser and Bjornn 1979).

Spawning may begin as early as late December and can extend into April with peaks from January through March (Hallock et al. 1961). Unlike Chinook salmon, not all steelhead die after spawning. Some may return to the ocean and repeat the spawning cycle for two or three years, however, the percentage of repeat spawners is generally low (Busby *et al.* 1996). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Everest 1973, Barnhart 1986). Gravels of 1.3 cm to 11.7 cm in diameter (Reiser and Bjornn 1979) and flows of approximately 40-90 cm/second (Smith 1973) are generally preferred by steelhead. Reiser and Bjornn (1979) reported that steelhead prefer a water depth of 24 cm or more for spawning. The survival of embryos is reduced when fines of less than 6.4 mm comprise 20 - 25% of the substrate. Studies have shown a survival of embryos improves when intragravel velocities exceed 20 cm/hour (Coble 1961, Phillips and Campbell 1961). The preferred temperatures for spawning are between 39° F and 52° F (McEwan and Jackson 1996).

Length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable; hatching varies from about 19 days at an average temperature of 60° F to about 80 days at an average of 42° F. The optimum temperature range for steelhead egg incubation is 46° F to 52° F (Bovee 1978, Reiser and Bjornn 1979, Bell 1986, Leidy and Li 1987). Egg mortality may begin at temperatures above 56° F (McEwan and Jackson 1996). After hatching, pre-emergent steelhead fry remain in the gravel living on yolk-sac reserves for another four to six weeks, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, steelhead fry typically inhabit shallow water along perennial stream banks. Older steelhead fry establish territories which they defend. Streamside vegetation is essential for foraging, cover, and general habitat diversity. Steelhead juveniles are usually associated with the bottom of the stream. In winter, they become inactive and hide in available cover, including gravel or woody debris.

The majority of steelhead in their first year of life occupy riffles, although some larger steelhead inhabit pools or deeper runs. Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperatures influence the growth rate, population density, swimming ability, ability to capture and metabolize food, and ability to withstand disease of these rearing juveniles. Rearing steelhead juveniles prefer water temperatures of 45° F to 60° F (Bovee 1978, Reiser and Bjornn 1979, Bell 1986). Temperatures above 60° F have been determined to induce varying degrees of chronic stress and associated physiological responses in juvenile steelhead (Leidy and Li 1987).

After spending one to three years in freshwater, juvenile steelhead migrate downstream to the ocean. Most Central Valley steelhead migrate to the ocean after spending two years in freshwater (Hallock et al. 1961, Hallock 1989). All emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as migration corridor to the ocean. Some steelhead may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to the final portion of their emigration to the sea. Barnhart (1986) reported that steelhead smolts in California range in size from 14 to 21 cm (fork length). In preparation for their entry into a saline environment, juvenile steelhead undergo physiological transformations known as smoltification that adapt them for their transition to salt water. These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents (Saunders 1965, Folmar and Dickhoff 1980, Smith 1982). In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition (Walters et al. 1978). The optimal thermal range during smoltification and seaward migration for steelhead is 44° F to 52° F (Leidy and Li 1987, Rich 1997) and temperatures above 55.4° F have been observed to inhibit formation and decrease activity of gill (Na and K) ATPase activity in steelhead, with concomitant reductions in migratory behavior and seawater survival (Zaugg and Wagner 1973, Adams et. al 1973). Hallock et al. (1961) found that juvenile steelhead in the Sacramento Basin migrated downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall. Steelhead spend between one and four years in the ocean (usually one to two years in the Central Valley) before returning to their natal streams to spawn (Barnhart 1986, Busby *et al.* 1996).

The factors affecting the survival and recovery of Central Valley steelhead are primarily associated with habitat loss (McEwan 2001). McEwan and Jackson (1996) attribute this habitat loss and other habitat problems primarily to water development resulting in inadequate flows, flow fluctuations, blockages, and entrainment into diversions. Other habitat problems related to land use practices and urbanization have also contributed to steelhead declines (Busby et al. 1996). Some stressors, especially summer water temperatures cause significant effects to steelhead since juvenile steelhead rear in freshwater for more than one year. Suitable steelhead conditions primarily occur in mid to high elevation streams. Because most of the suitable habitat has been lost to dam construction, juvenile rearing is mostly confined to lower elevation reaches where water temperatures during late summer and early fall can be high.

Many of the habitat improvements that have been implemented in Sacramento and San Joaquin river watersheds, including water management through the CVPIA B2 water supply and the CALFED EWA, improved screening conditions at water diversions, and changes in inland fishing regulations (there is no ocean steelhead fishery) benefit steelhead, however, many dams and reservoirs in the Central Valley do not have water storage capacity or release mechanisms necessary to maintain suitable water temperatures for steelhead rearing through the critical summer and fall periods, especially during critically dry years (McEwan 2001). The future of steelhead is uncertain because of the lack of trend data, especially for San Joaquin River tributaries. The likelihood of recovery of Central Valley steelhead will depend on future water allocations from reservoir systems, continued and enhanced protection and improvement of habitat, improved monitoring to determine population trends, as well as future climatic and oceanic conditions.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat, and ecosystem within the action area (USFWS and NMFS 1998).

A. Status of the Listed Species and Critical Habitat in the Action Area

Very little data exists on fisheries resources in the Calaveras River until recent monitoring efforts, however, there is little documentation of historical steelhead distribution in the entire Central Valley. There are historic accounts of large salmonids being sighted and caught in the river before the dam was built and upstream of the dam's current location. In 1980 the U.S. Fish and Wildlife Service prepared a planning aid letter stating that the Calaveras River supported a chinook salmon run prior to the construction of New Hogan Dam. They estimated that prior to Hogan Dam construction about 2,000 winter-run and 500 fall and spring-run Chinook salmon, and 500 steelhead trout ascended the river to spawn (USFWS 1980). In 1982, fish population estimates in the Calaveras River included 1,000 winter-run and 50 fall-run Chinook salmon, and 100 steelhead (USFWS 1989). The broad historical distribution of chinook salmon in the Central Valley (Yoshiyama *et al.* 1996,1998) corroborates the conclusion that steelhead were widely distributed (McEwan 2000). Evidence supporting the assumption that steelhead distribution can be inferred from chinook salmon distribution is provided by an extensive review done by CH2M Hill (1985). Yoshiyama *et al.* (1996) contend that steelhead were more widely distributed than chinook salmon. These inferences and anecdotal information provide sufficient justification for an assumption to be made that steelhead were historically present in the Calaveras River. The DFG has taken the position that steelhead were historically present in the Calaveras River and continue to exist in the lower reaches today (DFG 2002).

The Calaveras River watershed, with no snowmelt contributing to flows, relies predominantly on rain events to contribute to high flow conditions. Anadromy may have been blocked during certain flow regimes such as during drought years, however, during years with sufficient rainfall steelhead and late fall-run salmon likely used the Calaveras River for spawning and rearing. Historic flow data from 1907 to 1929, prior to construction of Hogan Dam in 1930, indicate that favorable flow conditions occurred during winter rains nearly every year (Figure 2, Table 1). Habitat conditions in the lower Calaveras River and Mormon Slough have always been suboptimal for salmonids during the dry season because of the hydrologic conditions and elevated temperatures associated with valley floor drainages, however, conditions are suitable once they migrated above Bellota. The current favorable conditions below New Hogan Dam are being enhanced during summer months by substantial releases from the lake for irrigation needs downstream.

During the period from 1972 - 1984 a "winter run" of approximately 100-1,000 Chinook salmon migrated up the Calaveras and spawned just below New Hogan Dam (Yoshiyama *et al.* 1996). They are thought to have been extirpated by successive years of minimal flows due to the 1987 -

1992 drought and irrigation diversions (Yoshiyama *et al.* 1996). The USFWS states that populations of salmonids in the Calaveras River dropped dramatically in the mid-late 1980s due to insufficient stream flows during critical times of the year, impairment of migration, and unscreened diversions (USFWS 1989). Due to the ephemeral nature of flows in the lower Calaveras River during summer it seems unlikely that watershed conditions would have supported spring-run Chinook salmon because they require cool, deep pools to in which to over-summer before spawning in the fall. Summer and early fall has historically been the lowest flow period for the Calaveras River.

Central Valley steelhead presently occur in the Calaveras River below New Hogan Lake despite often unfavorable conditions to facilitate upstream migration. It is often the case that the current release flow regime differs drastically from the natural flow regime. Fall flows are often extremely low and spring flows are blocked by the onset of agriculture season and the installation of irrigation dams. Passage conditions in Mormon Slough and the Stockton Diverting Canal are often poor with insufficient depth due to the trapezoidal channel and low flow releases from New Hogan Lake.

In March, 2000, 21 steelhead or rainbow trout were observed stranded in pools below New Hogan Dam(McEwan 2000). California Department of Fish and Game removed three carcasses for examination and determined one male to have spent 4+ years in freshwater, one female to have reared in freshwater for two years and the ocean for 1+ years, and another male spent 2+ years in freshwater and 1+ in an estuary. In 2001, steelhead in the Calaveras River were observed spawning with what appeared to be smaller *O. mykiss* which may not have been to the ocean (T. Kennedy, FF, pers.comm.; and author, pers.obs.).

B. Factors Affecting Species Environment within the Action Area

The essential features of salmonid habitat include adequate: (1) water quantity, quality, temperature, and depth; (2) cover/shelter and food; (3) habitat quality; (4) riparian vegetation; (5) substrate; and (6) safe passage conditions. In the action area, these features presently are affected by human activities such as the operation of New Hogan Reservoir in the Calaveras River, urban and agricultural water diversion and drainage in the Calaveras River and San Joaquin River basin, and dredging, levee maintenance, and boating activities that occur in the Calaveras River, Fourteen Mile Slough, and San Joaquin River.

During the non-flood season, operational releases from New Hogan Lake are called for by the Watermaster, SEWD, as authorized by the contract between Reclamation, CCWD and SEWD. SEWD and CCWD have rights under the contract to the 152,100 to 317,000 acre-feet of water supply storage space in New Hogan Lake. These districts have rights to the entire yield of the existing project under the current contract. With the exclusion of water released for flood control purposes and water in the minimum pool, the water available from New Hogan Dam is allocated to the two water districts primarily on a percentage basis. SEWD has rights to 56.5% of project yield plus 12,650 acre-feet for the downstream riparian and senior water right holders, and the

CCWD has rights to 43.5% of project yield plus 350 acre-feet. The contract gives SEWD the exclusive right to determine the rate of release of water from the water supply pool. The Corps determines releases when the water level rises above the top of the water supply pool and into the flood control pool.

Reservoir operation and water diversion typically result in seasonally reduced flow and concomitant elevated water temperature. Flow releases from New Hogan Dam are intended for agriculture and municipal use by the City of Stockton. The Calaveras River is over-allocated, and, as such, little or no flows pass the farthest downstream irrigation diversion point along the river or on Mormon Slough, most spring, summer, and early fall months (CH2M Hill 1999). The main water diverter, SEWD, diverts about two-thirds of their water deliveries at Bellota into Mormon Slough, with the remaining one-third routed down the old Calaveras River channel (see Figure 1). There are no mandatory daily flow requirements from New Hogan to protect anadromous fish below the dam, and there are no mandatory minimum flow requirements below the Bellota Weir to allow for safe passage. Flows during the irrigation season (April 15 - October 15) are increased in between New Hogan and Bellota, however, migration to or from the ocean and the Delta is blocked by numerous check dams. The BOR has the permit to store and divert water from the Calaveras River watershed (under WR Application 18812), not the Corps. A fish ladder was built by DFG to provide passage above the Bellota weir, however, it has not been shown to be effective and it is not installed during some portions of the migration period for salmonids. In 2001 it was not installed until February and in 2002 it was installed in October yet removed during the first week of March. These factors are likely decreasing the upstream migration opportunities for steelhead.

New Hogan Dam alters the flow regime of the Calaveras River and blocks the importation of gravel from the watershed upstream of the lake. Peak flood flows necessary for gravel recruitment associated with channelbed mobilization, removal of fine sediments from gravel bars, channel migration, and inundation of floodplains have been virtually eliminated in areas immediately below New Hogan Dam. The result has been a buildup of embedded fine sediments within gravels, encroachment of riparian vegetation on gravel bars, and an overall decrease in amount and quality of spawning areas.

Other impacts include the unscreened Brookside Estates water diversion located on the lower Calaveras River which may entrain fish, as well as numerous unscreened agricultural diversions on Mormon Slough and along the length of the river. Pollutants enter waterways through urban and agricultural drainage as well as boating activities. Stormwater releases from two Brookside Estates pump discharge stations are directed into the Calaveras River. Dredging activities suspend sediment and impact water quality. Levee maintenance typically results in the loss of riparian and shaded riverine aquatic (SRA) habitat.

Flood Control Operations

During flood control operation periods, the Corps is in charge of flow releases from New Hogan Dam. The rampdown of flow releases which occurred during March 2000 resulted in dewatering a portion of the Calaveras River channel located adjacent to the main wetted channel. This portion of the channel (called the overflow area) is only inundated during relatively high flows, estimated to be approximately 800 - 1000 cfs and greater (M.Stewart, Corps; pers.comm). It is not known how steelhead are using this habitat when available, however, gravel in this area may be preferable for spawning which induces fish to locate in this section of the channel. Gravel in the adjacent channel appears to be moderately to highly embedded with fine sediment whereas the overflow area contains suitable sized spawning gravels with fewer fine sediments. The overflow area is also pocketed with depressions made by mining activities which may serve as fish trap areas. Also, riparian vegetation, mainly willows, have encroached in this area which may have blocked exit channels during the flow rampdown. During the period from 1966 to 2001, flood control releases were done in eighteen out of thirty-eight years (Table 2, Figure 3).

The March, 2000 stranding event occurred during a flow rampdown from over 1000 to approximately 300 cfs and resulted in 13 fish being relocated by anglers, and 8 fish reported as stranded and dead. Flow conditions, specifically insufficient flow for upstream migration in the late-fall and downstream in the spring, and the fish ladder not being installed at Bellota has likely prevented *O. mykiss* in many years from undertaking an anadromous life history. Central Valley rainbow trout populations, with access to the Delta and ocean, can exhibit polymorphic life histories with progeny of one life-history form assuming a different life-history pattern (McEwan 2000).

The Corps determines flood control releases when the project is in flood control mode in accordance with the 1983 Water Control Manual and Flood Control Diagram. At all other times, operational releases are called for by the Watermaster, SEWD, as authorized by the contract between the BOR and SEWD and CCWD. Depending on the type of water year, the project may or may not enter into flood control mode. During the winter months when steelhead may be attempting to migrate upstream, flows may be insufficient to provide upstream passage because the Watermaster is filling the reservoir and thus making minimal releases.

Past Temporary Deviations from the Water Control Plan

During 1998, SEWD requested and was granted a temporary deviation from the Water Control Plan which allowed for continued storage of up to approximately 185,000 ac.-ft. On December 1, 1998. They were allowed to carry over an additional 33,000 ac.-ft. of inflow in the lake during the winter to provide for additional water supply for consumptive use in the following years. This increase in storage temporarily encroached into the flood control space of New Hogan Lake. Maintaining the additional storage was subject to the condition that all carryover storage would be reduced in the event the Corps determined it necessary to avoid damage or injury to persons or property downstream of New Hogan Lake because of possible flooding of the Calaveras River. This action did not jeopardize flood control needs or alter other conservation storage uses.

The National Environment Policy Act (NEPA) process concluded in issuance of a Finding of No Significant Impact (FONSI) and the deviation was granted. The U.S. Fish and Wildlife Service responded during the NEPA process with a recommendation to provide additional flows for improved benefits to salmonids. They specifically requested a minimum flow of 40 cfs from Bellota to tidewater from Nov. 17, 1998 to March 30, 1999 and to provide pulse flows during smolt outmigration period (after March 30, 1999) of a minimum 50 cfs for two, 5-day pulses to be coordinated with pulses in the San Joaquin River. According to the New Hogan Daily Computations, 1980-2000, provided in Appendix A of the BA prepared by the Corps for this consultation, storage in New Hogan reached a level greater than 185, 000 and then flood control releases began with at least 37 days between January 31, 1998 and February 16, 1999 having outflows exceeding 1000 cfs, and with four days of releases exceeding 7000 cfs (Figures 2A,B,C, and 3). The winter of 1998/1999 turned out to be a high rainfall year which ultimately nullified the need for a deviation, however, carrying over additional storage in New Hogan Lake did not cause adverse impacts to flood control operations. Future allowances of some carryover in New Hogan Lake during early winter to allow for some flow releases during late winter when steelhead migrate upstream and spawn could facilitate upstream passage and improve spawning conditions without interfering with irrigation needs in spring and summer.

Overall, the current identified major impacts to salmonids in the Calaveras River drainage arise from seasonal reduced flows that inhibit upstream migration by adult steelhead and downstream outmigration by steelhead smolts, and the continued existence of migration passage barriers in Mormon Slough and at the Bellota diversion weir. During irrigation season when weirs are in place, water operations on the Calaveras River, are predominantly under the jurisdiction of the Watermaster, SEWD. Other potential impacts to steelhead success in the Calaveras River may be identified during the ongoing CALFED-funded research project examining the limiting factors. Potential limiting factors could include a lack of high-quality spawning gravel areas, limited amount of rearing habitat, and poor smolt outmigration success rate.

The Calaveras River currently supports a seemingly healthy rainbow trout/steelhead (*O. mykiss*) fishery, as reported by the fishing community, despite many years with difficult passage conditions. Permanent solutions to the passage barrier problems and sufficient flow allocations during steelhead migration, spawning, hatching, and outmigrating time periods would likely result in an increase in number of steelhead using the river. Without any changes in the current conditions, the number of steelhead using the Calaveras River would likely remain as it is currently, with opportunistic use occurring during extreme high winter storm flows which allow fish to migrate upstream and downstream past the barriers during a window of time associated with a particular range of flows. The frequency and duration of this window of opportunity is not currently known, nor is trend data known.

Ongoing Studies

Several studies on the Calaveras River have been funded by CALFED and field work began in the fall or winter 2001. One funded project is a screening feasability study examining water diversions from Bellota Weir to New Hogan Dam and assessing them with regards to screening potential and need. Another study will examine steelhead and chinook salmon life history limiting factors within the lower Calaveras River. Data from these studies should provide information which will be useful in making decisions regarding flow operations and fish requirements, as well as in determining the current status of fisheries in the river. The current status of salmonids in the Calaveras River is largely speculative based on historical accounts, reports of anglers, and information gained from the March 2000 stranding event. Historical and current information indicates that with sufficient flows and free passage steelhead and chinook salmon will ascend and spawn in the river, however, the number of fish the Calaveras could support has not been determined. The Department of Water Resources (DWR) Fish Passage Improvement Program is currently undertaking a field study to identify barriers to fish migration in the channel from Bellota downstream to the confluence with the San Joaquin River. These data will be useful in determining the optimal course of action to modify or replace passage barriers.

V. EFFECTS OF THE ACTION

Continued operations of the New Hogan Dam by the Corps for flood control purposes may result in adverse effects to Central Valley steelhead. Lethal effects could occur during rampdown by stranding fish or dewatering redds, flood control releases could wash out redds, and dam operations impact downstream habitat through eliminating gravel recruitment from miles of upstream areas. Critical habitat may be affected through flow modifications which alter the natural hydrologic regime, altering or eliminating its functions. Elimination of many of the flushing flows may cause spawning gravel to become embedded with fine materials, reducing its effectiveness for spawning. Recruitment of gravels from areas upstream of New Hogan Dam is no longer able to occur and gravel replenishment is areas below the dam has been eliminated. Flow modification from operation of New Hogan Dam enables riparian vegetation to encroach on the channel which decreases the amount of available riffle areas and consequently reduces spawning sites. Reduced flow releases decrease the amount of habitat available to salmonids, for spawning and rearing, below New Hogan Dam. Low flows in fall and winter severely limit upstream migration of adult fish from the San Joaquin River, however, the Corps has jurisdiction over flows solely when the project is in flood control mode.

During low water years, such as 2001, the overflow area does not become inundated by flood control releases, and there is no possibility of fish being stranded in this manner. In a normal to wet water year, however, flows may be released from New Hogan Lake for flood control purposes and stranding becomes a possibility. A future stranding event would be a rare occurrence (i.e not every year) and a short-term event, however, the effects may result in steelhead becoming trapped and dying, and could cause a decrease in spawning success for the year.

The area below New Hogan Dam where stranding has occurred is periodically mined by the public and small pits are left. These pits form depressions where some of the trapped fish were found. In order to minimize the probability of future stranding, the Corps has proposed to ban mining activities and fill in the existing depressions by hand. They have also proposed to remove, by hand, some of the thick growth of willows which block migration routes out of this area. Implementation of these two measures would minimize the opportunity for future stranding in the mining pits at this site.

Flow Regime and Ramping Rates

The March, 2000, stranding event occurred when flood control releases were ramped down from approximately 1000 cfs to 300 cfs over an approximate three-hour period of time. According to the Corps website flow data, flows were decreased from 1000 cfs to 600 cfs during a 4-hour period, followed by three successive 100 cfs reductions in one hour , one half hour, and another half hour, for a total reduction of 700 cfs occurring over a 3- hour period. These ramping rates are within general guidelines set forth in the Flood Control Handbook used by the Corps, however, as was exhibited during the 2000 stranding event, implementing these ramp-down rates has the potential to cause fish to be stranded and die. During upstream migration and spawning periods, flow adjustments which increase or decrease the amount of available habitat could cause adult spawners to be stranded or render them unable to reach suitable spawning habitat. It could also result in decreased spawning success through dewatering of redds or reduction in amount of available spawning habitat.

Channel Modification

Ongoing operation of New Hogan Dam has resulted in channel modifications due to replacement of natural flows, including flood events, with regulated flows. Flow regulation directly affects sediment supply, including spawning gravel recruitment (Jackson & Beschta 1992, Kondolf & Wilcock 1996). The Calaveras River, below New Hogan Dam, has experienced a loss of gravel recruitment, from upstream reaches, which has been eliminated by dam construction. High flows redistribute sediments in a watercourse, flushing fine sediments from spawning gravels and allowing recruitment of gravels to downstream areas. Elimination of many of the flushing flows may cause available spawning gravel to become embedded with fine materials which decreases its suitability as spawning sites. Steelhead select spawning sites based on substrate composition, cover, water quality and quantity. Embryo survival and fry emergence depend on physical, hydraulic, and chemical variables including water velocity and depth, dissolved oxygen, water temperature, biochemical oxygen demand in the gravel, and permeability and porosity of the gravel in the redd (Bjornn and Reiser 1991). It is expected that continued operation of New Hogan Dam would cause chronic continual decrease in recruitment of suitable spawning gravels.

This would result in limited availability of spawning areas and decreased spawning success of Central Valley steelhead within the Calaveras River watershed.

Riparian vegetation has encroached on the channel in areas below the dam due to regulated flows and lack of gravel movement. Unregulated flows would include periodic winter storms that would result in bankfull or flood flows causing channelbed mobilization and replenishment of gravels in spawning areas, flushing out fine sediments, and clearing encroaching vegetation from within the bankfull channel. Infrequent large floods are no longer a part of the natural hydrologic regime and one result has been encroachment of riparian vegetation in the area below New Hogan Dam where the steelhead were stranded in March, 2000. Excessive vegetative growth may have contributed to fish becoming trapped as the flow receded. Continued, unchanged flow operations could result in steelhead once again becoming trapped by the combination of rapid flow reduction, migratory pathways clogged with vegetative growth, and depressions in the gravel pooling water. Trapped steelhead would die if there was no human intervention, i.e. relocation to flowing water.

Maintenance Actions

The Corps performs annual pre-flood inspections of New Hogan Dam typically during mid-November, after the irrigation season. Tunnels, outlet gates, and dam walls are inspected during this time. The inspections normally last one to two days with the flows reduced, if necessary, for 5-6 hours. Flows of less than 400 cfs are maintained by using the bypass capability of the power plant. Periodic 5-year inspections are conducted similar to the annual inspections except the inspection checklist is more complete and includes inspecting the plunge pool. No adverse effects to steelhead would be expected to occur, during both types of inspections, because sufficient flows are maintained using the bypass system during inspections unless steelhead redds were in the area and became temporarily dewatered. Timing of the inspections would be used to minimize any potential impacts to redds. Steelhead redds most likely would not be present during November.

Effects of Inter-related Actions

Operation of New Hogan Dam and Lake during most of the year is under the control of the watermaster, SEWD, and not the Corps, however, our effects analysis must include an analysis of the interrelated and interdependent actions associated with the Corps' actions. These actions include operation of the dam during non-flood control periods. SEWD releases flows to serve irrigation purposes in the spring through early fall. During this time period there are irrigation dams in place throughout the watershed which effectively eliminate the possibility of smolt outmigration and adult upstream migration. Irrigation season normally begins in mid-April, however, it may begin sooner in certain water years. The timing may result in some adult steelhead becoming trapped below the Bellota Weir where they would likely become trapped in Mormon Slough and die. Releases made during the fall and early winter are usually minimal and insufficient to accommodate adult upstream migration of steelhead. This may delay migration, reduce fecundity and decrease spawning success (if they are eventually able to ascend), and in entrapment and death in Mormon Slough or the Stockton Diverting Canal, as occurred to several Chinook salmon in November 2001 (G.Castillo, USFWS, pers.comm.).

Passage problems associated with the Bellota Weir are a constant impact whenever fish attempt to ascend upstream and when smolts attempt to migrate seaward. Fish are likely ascending above Bellota only during a small 'window of opportunity' when they can swim past the weir due to large storm flows. A fish ladder is installed during most years, however, it is improperly sized and may not ever be suitable for fish to utilize. The diversion at Bellota provides municipal and industrial water to the City of Stockton via a large unscreened diversion pipe. The water is used at the City of Stockton's wastewater treatment plant. Operation of the diversion at Bellota is likely taking juvenile fish by entrainment whenever they are diverting flow while fish are present within the area affected by flow diversion. This would result in fish being killed immediately or trapped at the settling ponds and dying as water temperature in the ponds becomes lethal to salmonids

Over all, water operations, as currently carried out by SEWD, are resulting in impacts to Central Valley steelhead through blocking upstream migration of adults, preventing smolts from outmigrating past mid-April, and trapping smolts that are below Bellota yet haven't reached the San Joaquin River on their way to the ocean. Low flow conditions during egg incubation may also be resulting in decreased reproductive success.

Overall Effects

Operation of New Hogan Dam on the Calaveras River is an ongoing action impacting the flow and sediment regime of the river. However, the Corps has jurisdiction over flow releases only during flood control conditions which only occurs during the rainy season when New Hogan Lake reaches a certain level, according to the Corps' Water Control Plan. During wet years when flood control releases are made, impacts to steelhead may occur as a result of flow fluctuations and rampdown. Impacts could include dewatering spawning habitat, decreasing the amount of available habitat for spawning or rearing, and causing fish to become trapped and killed.

Operation of New Hogan Dam contributes to channel modification because of an irregular flow regime, lack of gravel recruitment from the upper watershed which impacts the amount of available spawning habitat, and riparian vegetation encroachment which may also limit spawning habitat. Steelhead would continue to be adversely affected by future operation of New Hogan Dam if no changes were made to the operating plan. The number of steelhead using the Calaveras River may have historically constituted a small portion of the population of the entire ESU, however, this is not to diminish the contribution this population would provide to the genetics of San Joaquin River Central Valley steelhead. The polymorphic population structure exhibited by *O. mykiss* in the Calaveras River has allowed them to persist in an environment that is frequently suboptimal and not conducive to consistent, annual recruitment of migrants to or from the ocean. This strategy may be necessary for the long-term persistence of the population in this environment (McEwan 2001). The Calaveras River watershed has historically experienced low or non-contiguous flows in the late spring or summer months, however, steelhead in the system have been able to persist in this environment because of the plasticity of the life history of *O. mykiss*. There is some possibility of future take occurring as a result of the Corps' actions at New Hogan Dam, however, these actions proposed by the Corps and analyzed in this biological opinion, are not expected to reduce the likelihood of survival and recovery of the Calaveras River steelhead population due to the magnitude of the expected effects and their proven ability to persist in the highly variable environment of the Calaveras. Therefore, the proposed action is not expected to reduce appreciably the likelihood of survival and recovery of the Central Valley steelhead ESU.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Ongoing water diversions, agricultural practices, regulated flows during non-flood control operations, and continued use of numerous unscreened diversions between New Hogan Dam and the San Joaquin River are all expected to continue into the future. Downstream in the City of Stockton development is occurring and will continue, which may contribute to degradation of water quality and riparian function, and may put increasing pressure on water supply within the watershed, however, most of the land bordering the Calaveras River from Mormon Slough upstream to the New Hogan Dam is in agriculture production and is expected to continue. Impacts to fish would not increase as a result of continued agriculture operations.

VII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of Central Valley steelhead, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is NOAA Fisheries' biological opinion that ongoing operations by the Corps at the New Hogan Lake and Dam project, as proposed, are not likely to jeopardize the continued existence of threatened Central Valley steelhead Notwithstanding this conclusion, NOAA Fisheries anticipates that some actions associated with the proposed project may result in incidental take of these species. Therefore, an incidental take statement is included with this Biological Opinion for these actions.

VIII. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the proposed action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or the applicant must report the progress of the action and its impact on the species to NOAA Fisheries as specified in the incidental take statement. (50 CFR §402.14[i][3])

A. Amount or Extent of Take

NOAA Fisheries anticipates there is the possibility of incidental take of Central Valley steelhead caused by flood control operations, specifically by flow fluctuations within the 2001/2002 flood season. However, it is also anticipated that direct take by stranding may be minimized in the short-term and will be avoided in the future by implementation of ramping rates and some channel modification. NOAA Fisheries anticipates the incidental take of Central Valley steelhead in the following forms:

1. Adult steelhead which are present in the overflow area during rampdown of flow releases after flood control releases are made. They may be harmed, harassed, or taken during rampdown and authorized rescue operations. We anticipate the number to be less than 25 *O. mykiss* individuals based on the number of fish reported to have been stranded in March, 2000.

2. All progeny from any redds which are dewatered during a post flood control release rampdown. We anticipate the number of potential redds to be from zero to twenty based on the size of the gravel area and the number of fish reported to have been stranded in March, 2000.

3. All steelhead within the Calaveras River from Bellota to the New Hogan Dam harmed by flow fluctuations and lack of gravel recruitment downstream from New Hogan Dam. Take arising from a lack of gravel recruitment is expected to be unquantifiable and minimized over time through implementation of habitat restoration activities. Take resulting from flow fluctuations would include fish stranded during rampdown and is not expected to exceed ten steelhead.

B. Effect of the Take

In the accompanying biological opinion NOAA Fisheries determined that this level of anticipated take is not likely to result in jeopardy to Central Valley steelhead.

C. Reasonable and Prudent Measures

NOAA Fisheries believes the following reasonable and prudent measures are necessary and appropriate to minimize the incidental take of Central Valley steelhead caused by ongoing flood control operations at New Hogan Dam.

1. The Corps shall take measures to minimize the potential of a stranding event occurring in the future due to flood control operations.

2. The Corps shall develop and implement actions to restore channel characteristics.

3. The Corps shall take measures to minimize impacts of maintenance and inspection activities.

4. The Corps shall cooperate in activities designed to enhance steelhead fisheries habitat and production.

D. Terms and Conditions

1. The Corps shall take measures to minimize the potential of a stranding event occurring in the future due to flood control operations.

   a. The Corps shall utilize rampdown rates of approximately 100 cfs per hour when flood control releases are between 1,000 and 0 cfs, in order to allow for fish to be cued in to move out of the overflow area and into deeper water.

   b. During rampdown from flows of 600 cfs to approximately 200 cfs the channel below New Hogan Dam, to a distance downstream to the New Hogan Road bridge crossing, shall be monitored by the Corps for the presence of steelhead or other salmonids which could potentially become stranded. NOAA Fisheries shall be contacted when this [rampdown] is likely to occur, and may request to be present during rampdown monitoring. The NOAA Fisheries biologist to be contacted is F. Kelly Finn at (916)-930-3610, or if unavailable, the Sacramento office shall be contacted at (916)-930-3600. If potentially trapped fish are observed during rampdown of flood control releases of between 600 and 200 cfs, Corps personnel shall capture steelhead and handle them with extreme care while transporting them to the closest area with sufficient depth to release the fish, unharmed. NOAA Fisheries must be contacted and if desired may be present during relocation activities. If fish are found, Corps personnel or others onsite shall note numbers, locations, relative sizes, and condition of fish and include this information in a brief report for NOAA Fisheries. This information would be used in developing an adaptive management plan to design further modifications to reduce future stranding potential for salmonids.

2. The Corps shall develop and implement actions to restore channel characteristics.

a. The Corps shall design a plan to decrease stranding opportunities, in the area below New Hogan Dam downstream to the New Hogan Dam Road bridge, by various methods which may include: preventing future mining or other human activities which disturb gravels in the overflow area, filling in depressions which may serve as stranding areas, remove select areas of willow vegetation where growth has encroached on the channel and floodplain, and moving gravels from the overflow area to the main channel or supplement the main channel with suitable sized spawning gravels. NOAA Fisheries will assist in and approve of the plan before implementation. The Corps shall develop and implement a channel restoration section, as part of the overall plan, to determine the optimal solution to improve conditions below New Hogan Dam. Channel restoration goals shall include: improve spawning habitat/gravels, minimize or eliminate the potential for stranding during rampdown. Solutions may include in-channel work such as channel reconfiguring, creation of a low-flow channel, and gravel supplementation. Initial corrective actions shall be started within one year of the issuance of this final biological opinion.

b. The channel restoration plan must be accepted by NOAA Fisheries before implementation and completed by the start of the flood season, October 31, 2003.

c. The Corps shall monitor the channel after implementation of the channel restoration plan and use an adaptive management approach to determine if further action is required or if modifications to the plan should be made. NOAA Fisheries should be involved in the monitoring design and review.

All reports shall be mailed to:

Office Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814
FAX (916)-930-3629

3. The Corps shall take measures to minimize impacts of maintenance and inspection activities.

a. During maintenance and inspection the Corps shall ensure that bypass flows are approximately equal to flows prior to switching over to the bypass.

b. The Corps shall attempt to schedule maintenance and inspection activities to periods when adult salmonids or redds are least likely to be present just below the dam prior to the first fall rains and after irrigation season ends between September 1 and November 1.

c. The Corps shall monitor the inspection area at the plunge pool prior to the 5-year inspection, when dewatering will be incorporated into the inspection process, to insure salmonids are not harmed during plunge pool inspection. If salmonids are found to be present below the dam during the time of inspection the Corps shall visually monitor the site to insure no fish are temporarily stranded or disrupted. If required fish may be relocated by Corps personnel. Any detected disturbance to salmonids shall be reported immediately to NOAA Fisheries with sufficient time to allow NOAA Fisheries to be present during relocation.

To report fish relocation activities:
Contact: F. Kelly Finn, Fishery Biologist (916)-930-3610 or (916)-930-3600

4. The Corps shall cooperate in activities designed to enhance steelhead fisheries habitat and production.

a. The Corps shall examine the feasability of updating the (1983) Water Control Manual and Flood Control Diagram to determine if occasional or regular deviations may be implemented whereby additional storage from 3,000 to up to 30,000 acre-feet of storage may be granted for a temporary period of time annually and released to enhance flows for fisheries, specifically for steelhead upstream migration and spawning, and to a lesser degree for chinook salmon upstream migration. If it is determined to be feasible, the additional water held over in storage would be released to improve migratory conditions.

The 1983 plan did not include fisheries considerations; an updated plan should include considerations for steelhead life histories. If granted, the flows would be released during fall-spring prior to irrigation season with the cooperation of other relevant agencies. The deviations and releases would only be proposed for water years with sufficient rainfall and such that they do not impact other designated water uses. The 1998 deviation may be used as an example of a deviation from the Water Control Plan. A report on the feasability study and analysis should be submitted to NOAA Fisheries within one year of the issuance of this final biological opinion.

b. The Corps shall agree to work cooperatively with NOAA Fisheries, the Bureau of Reclamation, and water agencies to develop a water management plan which meets the flood control requirements; the water contracts to SEWD and CCWD; and allows fish to ascend, spawn, rear, and migrate to the maximum extent possible.

c. The Corps shall enhance gravel in the channel through supplementation of suitable sized spawning gravel in the area below New Hogan Dam, to be determined, as part of the restoration effort. Gravel supplementation would be implemented at sites agreed on by NOAA Fisheries and the Corps, using information obtained by ongoing studies. In-channel work would be done during the summer to avoid spawning and hatching periods.

IX. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat, to help implement recovery plans, or to develop information.

1. The Corps should support and promote habitat restoration activities, steelhead and salmon monitoring, and fish passage improvement surveys and activities within the Calaveras River drainage.

X. REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the proposed New Hogan Dam and Lake project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

XI. REFERENCES

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Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth new mandates for the National Marine Fisheries Service (NOAA Fisheries), regional fishery management councils, and federal action agencies to identify and protect important marine and anadromous fish habitat. The Councils, with assistance from NOAA Fisheries, are required to delineate "essential fish habitat" (EFH) in fishery management plans (FMPs) or FMP amendments for all managed species. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NOAA Fisheries regarding potential adverse effects of their actions on EFH.

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

Essential fish habitat is defined in the MSFCMA as: "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity..." NOAA Fisheries regulations further define "waters" to include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" to include sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" to mean the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" to cover a species' full life cycle..

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific coast salmon fishery includes waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (PFMC 1999). For the Calaveras River, the aquatic areas that may be identified as EFH for Pacific salmon are within the hydrologic unit map numbered 18040004 and portions of 18040011.

General life history information for chinook salmon is summarized below. Further detailed information on chinook salmon ESUs are available in the NOAA Fisheries status review of chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NOAA Fisheries proposed rule for listing several ESUs of chinook salmon (NMFS 1998).

Central Valley fall-run chinook enter the Sacramento and San Joaquin Rivers from July through April and spawn from October through December (FWS 1998) with spawning occurring from October through December although San Joaquin River populations tend to spawn later in the year than Sacramento River populations (Myers *et al.* 1998). Peak spawning occurs in October and November (Reynolds *et al.* 1993). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 6 inches, usually 1-3 feet to 10-15 feet. Preferred spawning substrate is clean loose gravel and gravels are unsuitable when they have been cemented with clay or fines or when sediments settle out onto redds reducing intergravel percolation (NMFS 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds et. al. 1993). At the time of emergence from their gravel nests, most fry disperse downstream towards the estuary shortly after they emerge or as smolts (Kjelson *et al.* 1982), hiding in the gravel or stationing in calm, shallow waters with fine sediments substrate and bank cover such as tree roots, logs, and submerged or overhead vegetation. Juvenile rearing occurs from January through mid May and the smaller fry inhabit marginal areas of the river, particularly back eddies, behind fallen trees, undercut tree roots or over areas of bank cover (Lister and Genoe 1970). Juvenile emigration occurs from mid March through mid June. Chinook salmon fry prefer slower velocity streambank areas and orient upstream to the current as opposed to the smolt stage that swims downstream with the current (Schaffter 1980). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade and protect juveniles from predation.

Principal foods of chinook salmon while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as Daphnia, flies, gnats, mosquitoes or copepods (Kjelson *et al.* 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates.

II. DESCRIPTION OF PROPOSED ACTION

The proposed action is described in the preceding biological opinion.

III. EFFECTS OF THE ACTION

Potential impacts of the ongoing New Hogan Dam and Lake project to Pacific coast salmon EFH would be similar to the effects of the action discussed in the preceding biological opinion concerning impacts to threatened Central Valley steelhead. These impacts include (1) habitat alteration due to dam operations, (2) migration access blocked due to low flows during adult upstream migration period, and (3) temporary reduction in habitat and potential disruption of spawning during periods when dam inspections are occurring. The potential impacts may be ameliorated through habitat restoration activities including addition of spawning gravels, migration access may be improved through flow releases during salmon migration and spawning in late fall-early winter, and timing dam inspections during times when salmon are unlikely to be present and ensuring bypass flows are maintained during inspection to the maximum extent practicable.

IV. CONCLUSION

Upon review of the effects of the New Hogan Dam and Lake project, NOAA Fisheries believes that it may adversely affect the EFH of fall-run chinook in the Calaveras River due to inadequate flows which reduce available habitat for spawning and rearing, and dam operations that eliminate natural flushing flows recruitment of gravel from above New Hogan Lake.

V. EFH CONSERVATION RECOMMENDATIONS

NOAA Fisheries recommends that Reasonable and Prudent Measures Nos. 2,3 and 4 and their respective Terms and Conditions listed in the Incidental Take Statement prepared for Central Valley steelhead in the preceding Biological Opinion be adopted as EFH Conservation Recommendations. In addition, NOAA Fisheries recommends that the ESA Conservation Recommendation be adopted as EFH Conservation Recommendations. These recommendations are provided as advisory measures:

- The Corps shall develop and implement actions to restore channel characteristics.
- The Corps shall take measures to minimize impacts of maintenance and inspection activities.
- The Corps shall cooperate in activities designed to enhance salmonid fisheries habitat and production.
- The Corps shall support and promote habitat restoration activities, steelhead and salmon monitoring, and fish passage improvement surveys and activities within the Calaveras River drainage.

VI. STATUTORY REQUIREMENTS

The MSFCMA and Federal regulations (50 CFR Sections 600.920) to implement the EFH provisions of the MSFCMA require federal action agencies to provide a written response to EFH Conservation Recommendations within 30 days of their receipt. A preliminary response is acceptable if final action cannot be completed within 30 days. Your final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH Conservation Recommendations, you must provide an explanation of the reasons for not implementing them.

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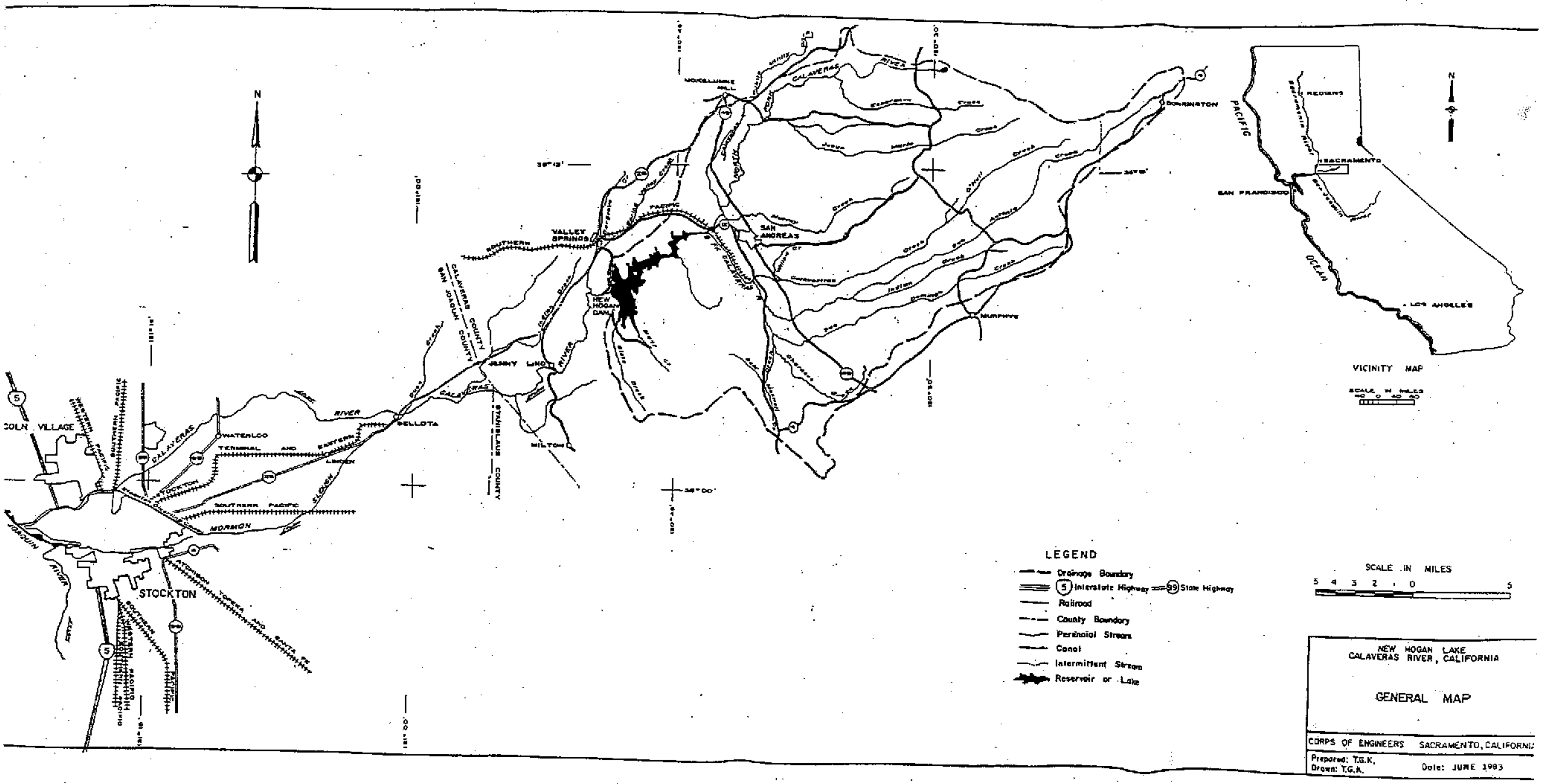
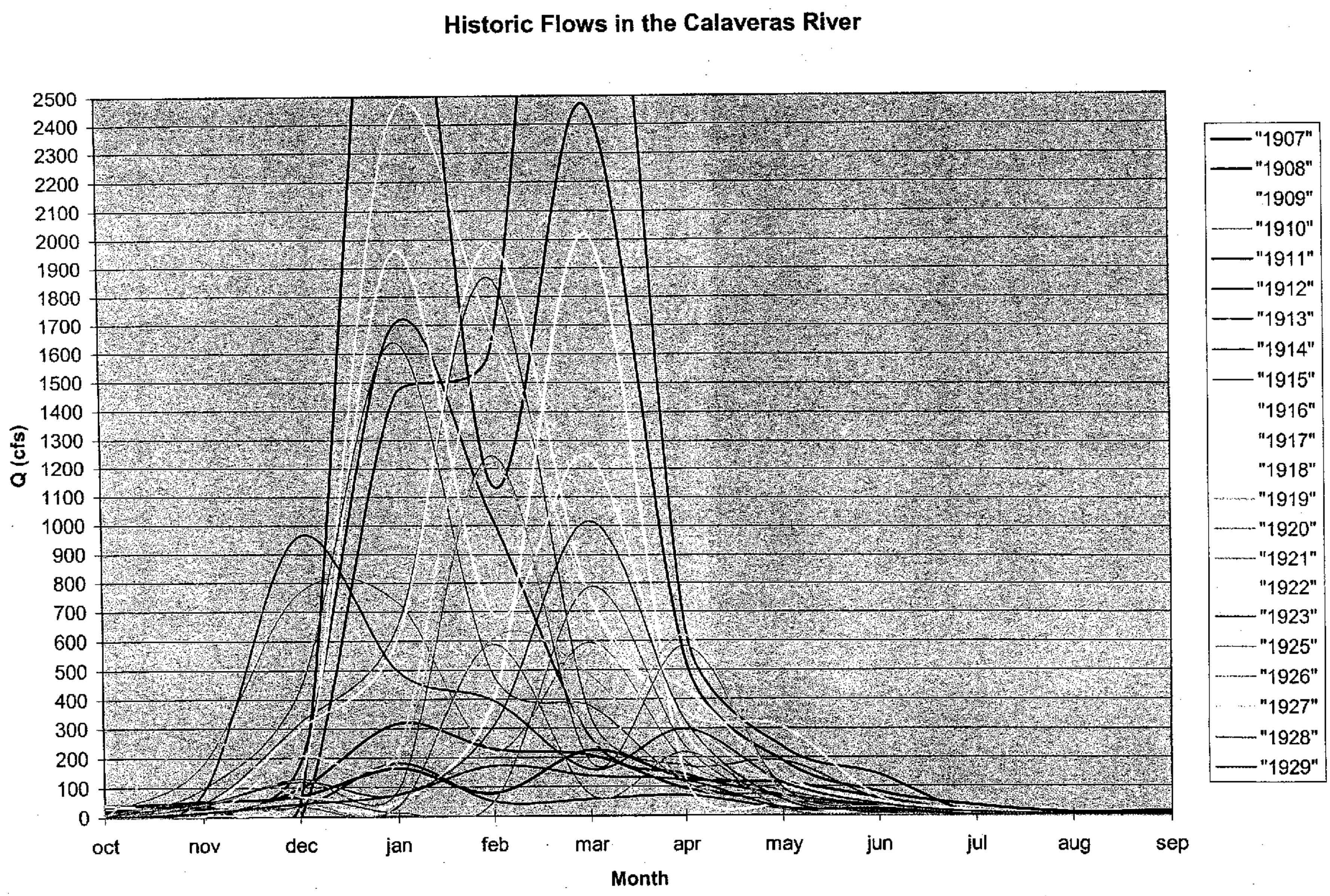
Figure 1



STOCKTON
VALLEY SPRINGS
NEW HOGAN DAM
SAN ANDREAS
MOKELUMNE HILL
BELLOTA
JENNY LIND
MILTON
WATERLOO
LINDEN
MURPHYS
DORRINGTON
CALAVERAS RIVER
SAN JOAQUIN COUNTY
CALAVERAS COUNTY
STANISLAUS COUNTY
SOUTHERN PACIFIC
TERMINAL AND EASTERN
MORMON SLOUGH
LEGEND
Drainage Boundary
Interstate Highway
State Highway
Railroad
County Boundary
Perennial Stream
Canal
Intermittent Stream
Reservoir or Lake
VICINITY MAP
SAN FRANCISCO
SACRAMENTO
LOS ANGELES
PACIFIC OCEAN
SCALE IN MILES
NEW HOGAN LAKE
CALAVERAS RIVER, CALIFORNIA
GENERAL MAP
CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA
Prepared: T.G.K.
Drawn: T.G.K.
Date: JUNE 1983

Figure 2


Historic Flows in the Calaveras River
Q (cfs)
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
oct
nov
dec
jan
feb
mar
apr
may
jun
jul
aug
sep
Month
"1907"
"1908"
"1909"
"1910"
"1911"
"1912"
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"1914"
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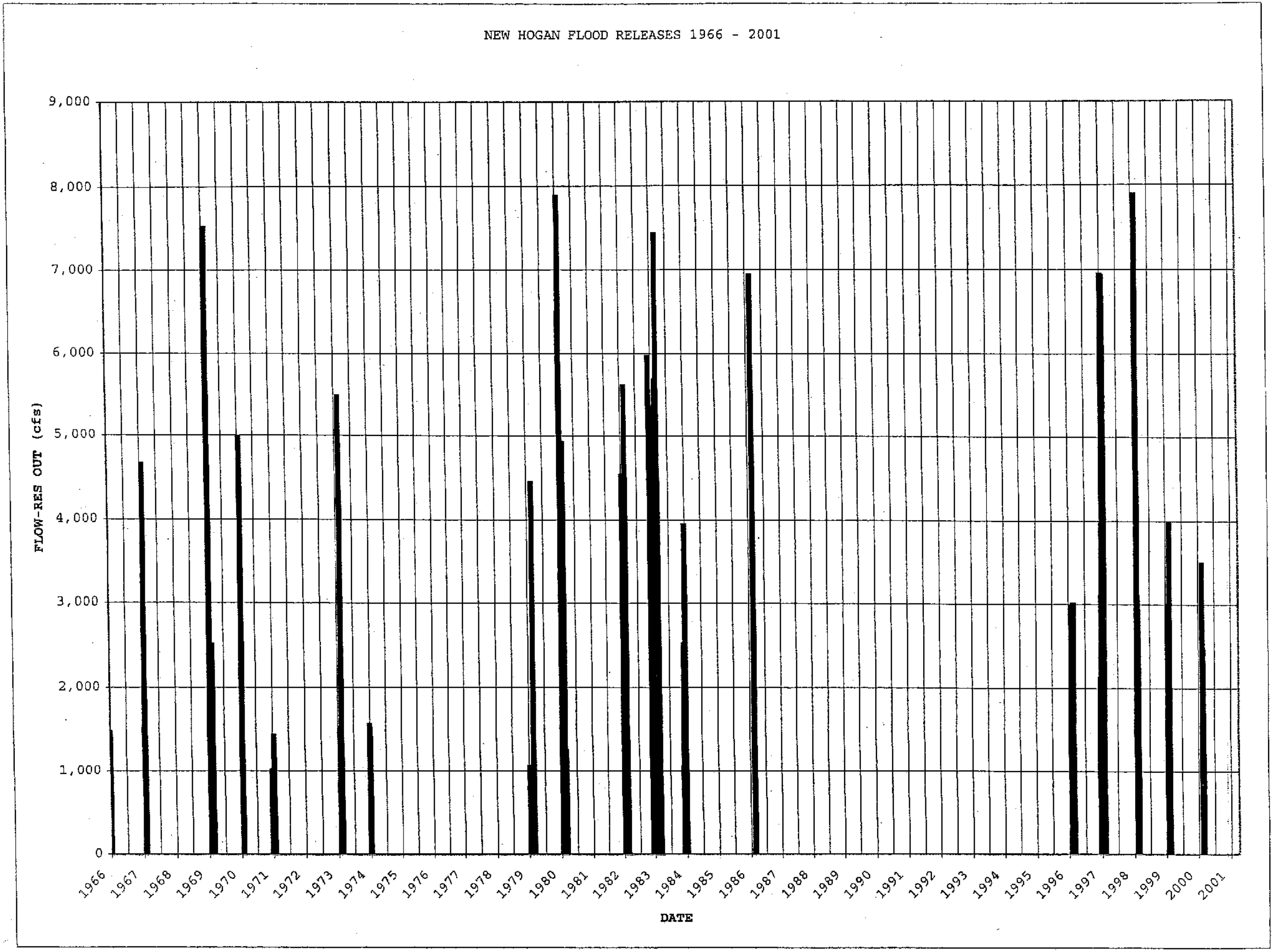
"1925"
"1926"
"1927"
"1928"
"1929"

Figure 5



NEW HOGAN FLOOD RELEASES 1966 - 2001
FLOW-RES OUT (cfs)
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1966
1967
1968
1969
1970
1971
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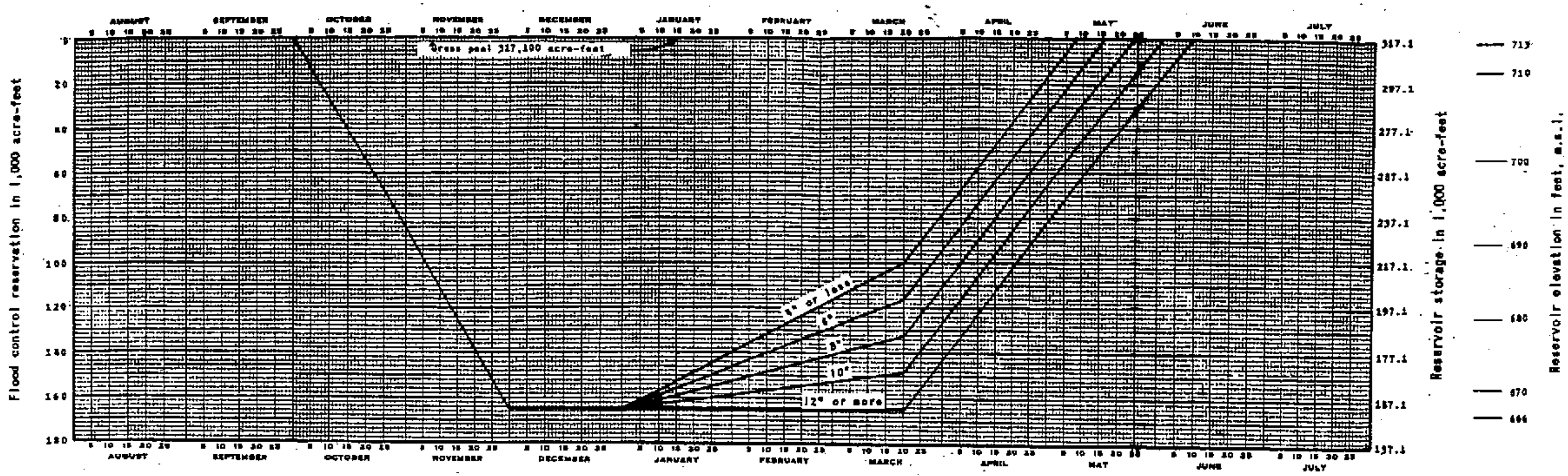
Figure 4



USE OF DIAGRAM

(1) Rainflood parameters relate the weighted accumulation of seasonal basin mean precipitation to the required flood control space reservation on any given day. Parameter values are computed daily by adding the current day's basin mean precipitation in inches to 96% of the parameter value computed through the preceding day. (An example of the determination of required flood control space reservation is illustrated.)

(2) Except when releases are governed by the emergency spillway release diagram and the Objective Flow Schedule, all water stored in excess of that indicated by this diagram shall be released as rapidly as possible, subject to the following instructions:

(a) That releases shall be limited to such quantities as will not cause flows at Bellota to exceed 12,500 c.f.s.

(b) That releases are not changed more than 2,000 c.f.s. in any 2-hour period.

(3) That releases do not exceed the maximum rate of inflow for the current event.

EXAMPLE OF DIAGRAM USE

PRECIP STATIONS	NAP (in.)	PRECIP TODAY (P) (in.)
New Hogan Dam	24.0	1.79
Rail Road Flat	36.0	1.70
Sheep Ranch	42.0	1.40
Perry Ranch	19.0	0.60
Total	121.0 (SNAP)	5.49 (STAP)

Basin Normal Annual Precipitation = (BNAP) = 33"

Basin Precipitation Computation (BP)

$$BP = \frac{BNAP}{SNAP}(STAP) = \frac{33.0}{121.0}(5.49)$$

BP = 1.0

PARAMETER AND ALLOWABLE STORAGE COMPUTATION

Par = P + 0.96 Par'

Par is today's parameter

Par' is yesterday's parameter

BP is basin precipitation

MONTH	DAY	BP	PAR'	PAR	REQUIRED FLOOD CONTROL SPACE (TAF)	ALLOWABLE STORAGE (TAF)
Sept	30	0	0	0	0	317.1
Oct	1	1.00	0	1.00	2.7	314.4
	2	2.00	1.00	2.96	5.4	311.7
	3	0	2.96	2.84	8.1	309.0
	4	0	2.84	2.73	10.8	306.3
Mar	10	--	--	1.00	108.2	208.9
	11	2.00	1.00	2.96	107.4	209.7
	12	3.00	2.96	5.84	120.7	196.4
	13	3.50	5.84	9.11	143.6	173.5
	14	2.50	9.11	11.25	159.4	157.7
	15	0	11.25	10.80	155.9	161.2
	16	0	10.80	10.37	152.4	164.7

TABLE 1
MEAN DAILY HISTORICAL UNIMPAIRED FLOWS
NEW HOGAN LAKE AND DAM (cfs)

WY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1907	0	0	0	1452	1610	4243	638	236	140	0	0	0	8319
1908	0	0	98	317	229	207	93	47	33	0	0	0	1023
1909	0	26	83	2422	1700	751	335	102	50	13	3	2	5487
1910	13	179	764	735	224	594	184	85	31	8	0	0	2817
1911	21	41	54	3521	1145	2467	532	187	81	34	11	15	8109
1912	36	52	72	164	78	226	128	112	60	7	2	11	948
1913	15	29	36	182	50	57	70	23	10	2	0	0	473
1914	0	7	184	1700	1028	265	141	68	31	10	0	0	3433
1915	44	49	319	647	1865	332	172	187	55	10	0	5	3685
1916	7	7	124	1956	693	1244	281	117	50	15	2	2	4497
1917	39	41	299	605	1986	748	351	304	62	10	0	2	4446
1918	2	15	31	50	395	2017	120	36	0	0	0	0	2666
1919	5	21	44	41	610	481	115	46	26	10	0	0	1399
1920	3	7	62	13	54	786	234	55	21	11	3	0	1249
1921	8	98	434	1639	481	376	111	65	20	0	0	0	3231
1922	0	2	207	226	1639	631	434	137	36	7	0	0	3318
1923	3	83	961	499	395	158	298	112	39	10	3	5	2566
1924	*	*	*	*	*	*	*	*	*	*	*	*	17
1925	0	39	130	94	1246	182	582	94	24	3	0	0	2396
1926	2	15	31	36	587	70	218	21	3	0	0	0	982
1927	0	267	70	195	1220	254	618	72	26	3	0	0	2724
1928	5	47	120	76	309	1016	322	52	15	2	0	0	1965
1929	0	15	44	75	172	137	120	26	23	0	0	0	611
1930	0	0	3	187	174	551	42	36	7	5	2	2	1008
1931	5	2	20	65	70	50	11	3	2	2	0	0	229
1932	0	0	607	353	894	128	55	59	11	0	0	8	2116
1933	0	0	0	171	102	132	49	57	8	2	2	2	524
1934	3	11	195	198	327	93	16	8	2	0	0	2	855
1935	3	21	67	522	124	504	886	135	41	26	2	7	2337
1936	0	5	13	450	2973	327	410	80	63	11	2	2	4336
1937	0	5	41	185	1488	1233	382	124	44	16	2	7	3526
1938	0	10	296	241	2412	1939	485	242	75	31	7	3	5739
1939	20	34	41	0	91	81	50	29	5	8	2	2	363
1940	0	0	13	703	1018	961	377	83	26	3	2	13	3199
1941	0	23	291	364	759	759	746	117	46	13	3	2	3124
1942	3	18	252	1052	569	311	447	309	101	29	5	2	3098
1943	7	150	289	984	611	1672	293	120	57	24	3	2	4212
1944	10	23	39	91	385	483	102	57	21	2	2	2	1216

Data from rtcoedb.dss
Reservoir filling 1964-1965

Table 2/1

NEW HOGAN FLOOD RELEASES 1966-2001

NEW HOGAN RELEASES 1966 - 2001 SOURCE:RTCOEDB.DSS

1964 FLOW-RES OUT DATE	1964 FLOW	1965 FLOW-RES OUT DATE	1965 FLOW	1966 FLOW-RES OUT DATE	1966 FLOW	1967 FLOW-RES OUT DATE	1967 FLOW	1968 FLOW-RES OUT DATE	1968 FLOW
NO FLOOD RELEASES		NO FLOOD RELEASES		5-Jan-66	1.450	23-Jan-67	1,520	NO FLOOD RELEASES	
				7-Jan-66	1,140	24-Jan-67	3,020		
						25-Jan-67	3,720		
						26-Jan-67	4,650		
						27-Jan-67	3,400		
						28-Jan-67	1,820		
						29-Jan-67	1,790		
						30-Jan-67	1,810		
						31-Jan-67	1,820		
						1-Feb-67	1,820		
						2-Feb-67	1,800		
						3-Feb-67	989		

1969 FLOW-RES OUT DATE	1969 FLOW	1970 FLOW-RES OUT DATE	1970 FLOW	1971 FLOW-RES OUT DATE	1971 FLOW	1972 OUT DATE	1972 FLOW
20-Jan-69	2,380	16-Jan-70	513	17-Dec-70	304	NO FLOOD RELEASES	
21-Jan-69	5,747	17-Jan-70	2,246	18-Dec-70	754		
22-Jan-69	7,347	18-Jan-70	3,912	19-Dec-70	990		
23-Jan-69	7,500	19-Jan-70	4,961	20-Dec-70	990		
24-Jan-69	7,500	20-Jan-70	4,935	21-Dec-70	990		
25-Jan-69	6,593	21-Jan-70	4,956	22-Dec-70	990		
26-Jan-69	7,500	22-Jan-70	4,967	23-Dec-70	990		
27-Jan-69	7,500	23-Jan-70	4,903	24-Dec-70	990		
28-Jan-69	7,500	24-Jan-70	4,880	25-Dec-70	990		
29-Jan-69	6,946	25-Jan-70	4,840	26-Dec-70	1,000		
30-Jan-69	4,400	26-Jan-70	4,760	27-Dec-70	1,000		
31-Jan-69	2,671	27-Jan-70	3,831	28-Dec-70	1,000		
1-Feb-69	1,741	28-Jan-70	1,448	29-Dec-70	767		
2-Feb-69	1,520	29-Jan-70	845	30-Dec-70	600		
3-Feb-69	1,030	30-Jan-70	736	31-Dec-70	538		
8-Feb-69	1.137	31-Jan-70	492	1-Jan-71	408		
9-Feb-69	1,480			2-Jan-71	285		
10-Feb-69	1,480			3-Jan-71	300		
11-Feb-69	1,480			4-Jan-71	249		
12-Feb-69	1,480			5-Jan-71	210		
13-Feb-69	1,480			6-Jan-71	208		
14-Feb-69	1,480			14-Jan-71	369		
15-Feb-69	1,480			15-Jan-71	955		
16-Feb-69	1,480			16-Jan-71	1,410		
17-Feb-69	1,480			17-Jan-71	1,400		
18-Feb-69	1,480			18-Jan-71	1,408		
19-Feb-69	2,039			19-Jan-71	877		
20-Feb-69	2,497			20-Jan-71	488		
21-Feb-69	2,476			21-Jan-71	362		
22-Feb-69	2,468			22-Jan-71	253		
23-Feb-69	2,480						
24-Feb-69	2,486						
25-Feb-69	2,492						
26-Feb-69	2,492						
27-Feb-69	1,690						
28-Feb-69	847						

1973 FLOW-RES OUT DATE	1973 FLOW	1974 FLOW-RES OUT DATE	1974 FLOW	1975 FLOW-RES OUT DATE	1975 FLOW	1976 FLOW-RES OUT DATE	1976 FLOW	1977 FLOW-RES OUT DATE	1977 FLOW	1978 FLOW-RES O[...] DATE	F[...]
26-Jan-73	870	28-Dec-73	849	NO FLOOD RELEASES		NO FLOOD RELEASES		NO FLOOD RELEASES		NO FLOOD RELE[...]	
27-Jan-73	1,463	29-Dec-73	1.544								
28-Jan-73	1,480	30-Dec-73	1,500								
29-Jan-73	702	31-Dec-73	1,492								
30-Jan-73	523	1-Jan-74	1.488								
31-Jan-73	1,280	2-Jan-74	1,481								
1-Feb-73	1,500	3-Jan-74	1,481								
2-Feb-73	1,560	4-Jan-74	1,481								
3-Feb-73	1,500	5-Jan-74	1,476								
4-Feb-73	1,490	6-Jan-74	1,498								
5-Feb-73	1,480	7-Jan-74	1,461								
6-Feb-73	1.490	8-Jan-74	1,481								
7-Feb-73	1,500	9-Jan-74	922								
8-Feb-73	1,490										
9-Feb-73	1,483										
10-Feb-73	1,507										
11-Feb-73	2,117										
12-Feb-73	3,804										
13-Feb-73	5,470										
14-Feb-73	4,895										
15-Feb-73	4,559										
16-Feb-73	3,222										
17-Feb-73	1,370										
18-Feb-73	720										

Table 2/2

1979 FLOW-RES OUT DATE	1979 FLOW	1980 FLOW-RES OUT DATE	1980 FLOW	1981 FLOW-RES OUT DATE	1981 FLOW	1982 FLOW-RES OUT DATE	1982 FLOW
12-Jan-79	1,046	24-Jan-80	688	NO FLOOD RELEASES		5-Jan-82	2.388
13-Jan-79	1,038	15-Jan-80	5,618			6-Jan-82	4,528
14-Jan-79	1,035	16-Jan-80	6,482			7-Jan-82	3,588
15-Jan-79	1,031	17-Jan-80	2.262			8-Jan-82	2,562
16-Jan-79	1.027	18-Jan-80	2,426			9-Jan-82	1,586
17-Jan-79	765	19-Jan-80	2.016			10-Jan-82	610
18-Jan-79	597	20-Jan-80	4,278			20-Jan-82	662
19-Jan-79	507	21-Jan-80	7,864			21-Jan-82	1,572
20-Jan-79	505	22-Jan-80	7,448			22-Jan-82	1,689
21-Jan-79	501	23-Jan-80	4,357			23-Jan-82	1,206
22-Jan-79	226	24-Jan-80	2,322			24-Jan-82	721
23-Feb-79	1,260	20-Feb-80	1,070			25-Jan-82	242
24-Feb-79	4,290	21-Feb-80	1,390			15-Feb-82	1,418
25-Feb-79	4,440	22-Feb-80	3,800			16-Feb-82	4,965
26-Feb-79	3,690	23-Feb-80	4,910			17-Feb-82	5,605
27-Feb-79	1,470	24-Feb-80	3,390			18-Feb-82	5,425
		25-Feb-80	1,740			19-Feb-82	4,495
		26-Feb-80	1,140			20-Feb-82	3,519
						21-Feb-82	2,506
						22-Feb-82	1.503

1983 FLOW-RES OUT		1984 FLOW-RES OUT DATE	1984 FLOW	1985 FLOW-RES OUT DATE	1985 FLOW	1986 FLOW-RES OUT DATE	1986 FLOW
30-Nov-82	3,627	1-Dec-83	1,043	NO FLOOD RELEASES		18-Feb-86	2,354
1-Dec-82	5,957	2-Dec-83	1,043			19-Feb-86	3,789
2-Dec-82	5,852	3-Dec-83	1,034			20-Feb-86	5,799
3-Dec-82	5,884	4-Dec-83	1,025			21-Feb-86	6,844
4-Dec-82	4,998	5-Dec-83	1,025			22-Feb-86	6,926
5-Dec-82	4,040	6-Dec-83	1,311			23-Feb-86	6,916
6-Dec-82	2,533	7-Dec-83	1,923			24-Feb-86	6,277
22-Dec-82	3,051	8-Dec-83	2,474			25-Feb-86	5,067
23-Dec-82	4,580	9-Dec-83	2,492			26-Feb-86	4,228
24-Dec-82	4,023	10-Dec-83	2,502			27-Feb-86	3,452
25-Dec-82	3,314	11-Dec-83	1,879			28-Feb-86	1,685
26-Dec-82	2,979	12-Dec-83	1,366				
27-Dec-82	1,932	13-Dec-83	1,008				
23-Jan-83	2,104	25-Dec-83	2,565				
24-Jan-83	2,690	26-Dec-83	3,463				
25-Jan-83	4,466	27-Dec-83	3,934				
26-Jan-83	4,324	28-Dec-83	3,905				
27-Jan-83	3,314	29-Dec-83	3,875				
28-Jan-83	5,350	30-Dec-83	3,624				
29-Jan-83	3,846	31-Dec-83	3,463				
30-Jan-83	4,965	1-Jan-84	3,444				
31-Jan-83	3,993	2-Jan-84	3,444				
1-Feb-83	2,554	3-Jan-84	1.609				
2-Feb-83	1,565						
3-Feb-83	751						
7-Feb-83	1,959						
8-Feb-83	4.887						
9-Feb-83	5,675						
10-Feb-83	5,055						
11-Feb-83	3,232						
12-Feb-83	2,004						
13-Feb-83	2,049						
14-Feb-83	2,049						
15-Feb-83	1,247						
27-Feb-83	2,169						
28-Feb-83	3,305						
1-Mar-83	4,559						
2-Mar-83	6,631						
3-Mar-83	7,418						
4-Mar-83	5,793						
5-Mar-83	4,487						
6-Mar-83	4,466						
7-Mar-83	4,303						
8-Mar-83	3,078						
9-Mar-83	1,879						
10-Mar-83	1.017						

1987 FLOW-RES OUT DATE FLOW	1988 FLOW-RES OUT DATE FLOW	1989 FLOW-RES OUT DATE FLOW	1990 FLOW-RES OUT DATE FLOW	1991 FLOW-RES OUT DATE FLOW	1992 FLOW-RES OUT DATE FLOW	1993 FLOW-RES OUT DATE FLOW	1994 FLOW-RES DATE
NO FLOOD RELEASES	NO FLOOD RELEASES	NO FLOOD RELEASES	NO FLOOD RELEASES	NO FLOOD RELEASES	NO FLOOD RELEASES	NO FLOOD RELEASES	NO FLOOD RE

Table 2/3

1995 FLOW-RES OUT DATE	FLOW	1996 FLOW-RES OUT DATE	FLOW	1997 FLOW-RES OUT DATE	FLOW	1998 FLOW-RES OUT DATE	FLOW	1999 FLOW-RES OUT DATE	FLOW	2000 FLOW-RES OUT DATE	FLOW	2001 FLOW-RES OUT DATE	FLOW	2002 FLOW-RES OUT DATE	FLOW
NO FLOOD RELEASES		26-Jan-96	1,256	12-Dec-96	1,313	31-Jan-98	1,998	21-Jan-99	2,035	15-Feb-00	1,728	NO FLOOD RELEASES		NO FLOOD RELEASES	
		27-Jan-96	1,086	13-Dec-96	1,758	1-Feb-98	1,218	22-Jan-99	2,952	16-Feb-00	3,487				
		28-Jan-96	1,681	14-Dec-96	2,095	4-Feb-98	2,654	23-Jan-99	2,993	17-Feb-00	3,338				
		29-Jan-96	2,566	15-Dec-96	2,086	5-Feb-98	5,235	24-Jan-99	2,976	18-Feb-00	3,062				
		30-Jan-96	2,971	16-Dec-96	2,102	6-Feb-98	3,987	25-Jan-99	2,012	19-Feb-00	3,046				
		31-Jan-96	2,950	17-Dec-96	2,118	7-Feb-98	4,824	26-Jan-99	877	20-Feb-00	3,037				
		1-Feb-96	2,570	18-Dec-96	1,807	8-Feb-98	7,321	27-Jan-99	619	21-Feb-00	3,025				
		2-Feb-96	1,223	19-Dec-96	1,270	9-Feb-98	7,868	28-Jan-99	245	22-Feb-00	2,064				
		6-Feb-96	1,897	20-Dec-96	678	10-Feb-98	7,872	8-Feb-99	550	23-Feb-00	1,529				
		7-Feb-96	2,569	21-Dec-96	315	11-Feb-98	7,001	9-Feb-99	1,147	24-Feb-00	1,510				
		8-Feb-96	2,115	22-Dec-96	309	12-Feb-98	4,816	10-Feb-99	2,609	25-Feb-00	1,508				
		9-Feb-96	1,107	23-Dec-96	1,365	13-Feb-98	3,379	11-Feb-99	3,908	26-Feb-00	1,499				
		21-Feb-96	1,039	24-Dec-96	2,474	14-Feb-98	3,092	12-Feb-99	3,930	27-Feb-00	1,520				
		22-Feb-96	2,155	25-Dec-96	2,496	15-Feb-98	3,028	13-Feb-99	3,887	28-Feb-00	1,981				
		23-Feb-96	2,982	26-Dec-96	2,483	16-Feb-98	3,024	14-Feb-99	3,921	29-Feb-00	2,454				
		24-Feb-96	2,995	27-Dec-96	2,477	17-Feb-98	3,024	15-Feb-99	3,978	1-Mar-00	2,467				
		25-Feb-96	2,966	28-Dec-96	3,093	18-Feb-98	3,011	16-Feb-99	2,304	2-Mar-00	2,277				
		26-Feb-96	2,992	29-Dec-96	2,247	19-Feb-98	2,281			3-Mar-00	1,687				
		27-Feb-96	2,934	30-Dec-96	1,351	20-Feb-98	1,027			4-Mar-00	1,510				
		28-Feb-96	2,048	31-Dec-96	3,960	21-Feb-98	995			5-Mar-00	1,154				
		29-Feb-96	1,045	1-Jan-97	2,815	22-Feb-98	1,873								
				2-Jan-97	2,121	23-Feb-98	2,918								
				3-Jan-97	1,879	24-Feb-98	2,914								
				4-Jan-97	3,973	25-Feb-98	2,489								
				5-Jan-97	4,894	26-Feb-98	1,631								
				6-Jan-97	5,293										
				7-Jan-97	6,527										
				8-Jan-97	6,916										
				9-Jan-97	6,937										
				10-Jan-97	6,517										
				11-Jan-97	5,562										
				12-Jan-97	3,438										
				13-Jan-97	1,376										
				14-Jan-97	448										
				23-Jan-97	2,549										
				24-Jan-97	6,159										
				25-Jan-97	2,258										
				26-Jan-97	2,028										
				27-Jan-97	2,127										
				28-Jan-97	5,234										
				29-Jan-97	6,922										
				30-Jan-97	6,506										
				31-Jan-97	4,930										
				1-Feb-97	3,042										
				2-Feb-97	2,032										